

electrons and holes prior to recombination, the electrons and holes generated by photo absorption.

7. The optical device of claim 1, wherein the bottom channel layer and the top channel layer and the channel unit comprise 2D material layers in a single layer.

8. The optical device of claim 1, wherein the bottom channel layer and the top channel layer extend, relative to the channel unit, at a right angle, an acute, or an obtuse angle.

9. The optical device of claim 1, wherein the source electrode extends in a linear shape and the optical device further comprises a plurality of drain electrodes corresponding to the source electrode.

10. The optical device of claim 1, wherein at least one barrier layer of the at least two barrier layers includes a semiconductor layer, and the semiconductor layer includes at least one of a IV group semiconductor, a III-V group compound semiconductor, an oxide semiconductor, a nitride semiconductor, or an oxynitride semiconductor.

11. The optical device of claim 10, wherein the semiconductor layer includes at least one of a 2D semiconductor layer, a quantum dot-contained layer or a quantum dot layer.

12. The optical device of claim 10, wherein the semiconductor layer includes a 2D semiconductor layer, the 2D semiconductor layer including a metal chalcogenide-based material layer.

13. The optical device of claim 10, wherein the semiconductor layer includes a quantum dot layer, the quantum dot layer includes a plurality of quantum dots, and each quantum dot includes a core unit and a shell unit surrounding the core unit.

14. A method of manufacturing an optical device, the method comprising:

- forming a first channel layer on a substrate;
- forming a first barrier layer on the first channel layer;
- forming a second channel layer on the substrate, the second channel layer comprising a channel unit extended on at least a portion of the first barrier layer;
- forming a second barrier layer on the first barrier layer, such that the channel unit at least partially interposes between the first barrier layer and the second barrier layer;

forming a third channel layer on second barrier layer, such that the third channel layer covers an upper side surface of the second barrier layer and is connected to the first channel layer;

forming a drain electrode on the first channel layer; and forming a source electrode on the second channel layer.

15. The method of claim 14, further comprising:

prior to forming the third channel layer, laminating at least one barrier layer on the second barrier layer; and laminating, in an alternating sequence between barrier layers comprising the second barrier layer and the at least one barrier layer, channel units connected to the source electrode and channel layers connected to the drain electrode.

16. The method of claim 14, wherein the first channel layer and the second channel layer are formed at a right angle to each other, at an acute angle to each other, or at an obtuse angle to each other.

17. The method of claim 14, wherein the source electrode is formed to extend in a linear shape, and the method further comprises forming a plurality of drain electrodes which correspond to the source electrode.

18. The method of claim 14, wherein the first channel layer includes a metal layer.

19. The method of claim 14, wherein the first channel layer, the second channel layer, and the third channel layer include separate two-dimensional (2D) material layers in a single layer.

20. The method of claim 14, wherein the first barrier layer and the second barrier layer each include at least one of a 2D material layer and a semiconductor layer, and the first barrier layer and the second barrier layer each include different photo absorption characteristics.

21. The method of claim 14, wherein the first channel layer, the second channel layer, and the third channel layer each include at least one doped layer.

22. The method of claim 14, wherein a thickness of each barrier layer, of the first barrier layer and the second barrier layer is less than a particular distance traveled by electrons and holes prior to recombination, the electrons and holes generated by photo absorption.

* * * * *